

**Specifications for Inductively Coupled Plasma Reactive Ion Etching System
(CLIN 0001)**

1.00 Scope and basic description

This specification describes the minimum technical requirements and the minimum acceptable performance standards for an Inductively Coupled Plasma Reactive Ion Etching (ICP RIE) System to be installed by the contractor at the Naval Research Laboratory (NRL), Washington, DC. The ICP RIE system will be placed in a multiple user facility, within a Class 100 clean room, and must provide ease of operation and safety to those in the facility. The tool must be capable of dry etching a wide variety of materials including silicon (Si), silicon dioxide (SiO₂), silicon nitride (Si₃N₄), tantalum (Ta) and tungsten (W) and be capable of deep RIE of silicon. The system must be computer controlled via menu-driven software and user friendly.

2.00 The ICP RIE System features:

- 2.01 Must have room temperature Bosch process capability (complete with license documentation) and liquid nitrogen (LN₂) cooled electrode for low -temperature (Cryo) Si etching capability.
- 2.02 Must have a universal base console, housing the electronic sub systems, control units, pneumatics, and turbomolecular pump.
- 2.03 Must have an operating system such as Windows™-based or equivalent environment for operator interface of process control, wafer handling, real time data logging of process parameters, machine status and recipe management.
- 2.04 Must have an ICP process chamber equipped as follows:
 - Pumping port with a diameter between 150 to 250 mm.
 - Electrical heating cartridges for heating process chamber walls to reduce condensation of process effluents.
 - A view port and end-point-detection ports for optical emission and laser interferometer
- 2.05 Must have a lower electrode made of Al with a diameter between 175 – 210 mm. Must be capable of being cryo (LN₂) cooled or heated (temperature range -150°C to +400°C), and have active helium cooling and provide clamping for 3" and 4" wafers with integrated sputter guard.
- 2.06 Must include tooling for etching 3"& 4" wafers.
- 2.07 Must have remote high-density plasma source of at least a 380mm inside diameter with the following:
 - A maximum output of no less than 5kW RF power @13.56MHz.
 - An automatic matching unit that is close-coupled to the source.
 - A source utilizing an electrostatic shield to produce purely inductive plasma.

- 2.08 Must have an independent 600W RF generator connected to the lower electrode through a close-coupled automatic matching unit.
- 2.09 Must have a 100-millitorr (mT), temperature-stabilized capacitance manometer with isolation valve. Must have an active penning gauge.
- 2.10 Must have at least 200mm pumping port fitted with a variable gate valve (such as VAT series 64 or equivalent). Must have electrical heating jacket.
- 2.11 Must have a stainless steel gas pod with a minimum of 6 mass-flow-controlled process gas lines. All corrosive process gas lines must use metal-sealed mass flow controllers (MFC's). All non-corrosive gas lines must use elastomer sealed MFC's. Each line must be provided with a Unit 8100 MFC or equivalent compatible with the Bosch process.
- 2.12 Must have load lock chamber for vacuum loading of a single wafer into the process chamber. The load lock must have its own turbo and rotary pump filled with Fomblin brand or equivalent pump oil.
- 2.13 Process and base-pressure pumping must be accomplished by:
 - Alcatel 1300 l/s Mag Lev turbo pump or equivalent.
 - Alcatel ADP 122P dry pump or equivalent, in order to backup turbo pump.
- 2.14 The deep Si etch process is very sensitive to chamber conditions. In order to maintain the specifications at 3.00 for the deep Si etch process, a spare ICP tube must be included to be used only for this process. This accessory must be installed in such a manner for easy access (ex: replacement of tube must not exceed two hours).

3.00 Minimum Process specifications:

3.01 Process: Cryo Deep Si Etch

Process gases: Silicon Hexafluoride (SF₆), Oxygen (O₂)

Etch rate —	>4 μ m/min,
Selectivity —	>100:1 to photoresist > 200:1 to SiO ₂
Uniformity —	< \pm 5% on 150 mm wafer (with 7mm edge exclusion)
Reproducibility —	< \pm 3% (run to run)
Wall profile control —	90° \pm 1°
Aspect Ratio —	up to 30:1

3.02 Process: Bosch Deep Si Etch

Process gases:	Octofluorocyclobutane (C ₄ F ₈), SF ₆
Clean gases:	O ₂
Etch rate —	>2.5 μ m/min,
Selectivity —	> 75:1 to photoresist > 150:1 to SiO ₂
Uniformity —	< \pm 5% on 150 mm wafer (with 7mm edge exclusion)
Reproducibility —	< \pm 3% (run to run)
Wall profile control —	90 $^{\circ}$ \pm 1 $^{\circ}$
Aspect Ratio —	up to 30:1

4.00 Documentation:

4.01 The contractor must provide commercial documentation such as drawings and schematics necessary for full operation, troubleshooting, servicing and repair of the system and its components.

5.00 Installation:

5.01 The contractor shall install the system at the Naval Research Laboratory, Washington, DC.

5.02 The contractor shall unpack the system, inventory its contents and ensure that all packages have been received, advise on the placement of the system in its final location and prepare it for installation.

5.03 The Government will be responsible for securing the system to the floor, installing power, gas lines, and exhaust lines.

5.04 The contractor shall assist the Government in the verification of the installation, facilities readiness, power up the system, and verify that all hardware and software function properly.

5.05 The contractor shall assist the Government in the complete verification of system performance.

6.00 Warranty:

6.01 The contractor must provide a twelve (12) month commercial warranty from the date of inspection, installation and acceptance at the NRL site.

7.0 Options:

Option 1 (CLIN 0002)

Laser end point detector integrated with the system controller - 1 Each

Option 2 (CLIN 0003)

Additional spare clamp with sputter guard for 3, 4 and 6 inch wafers - 1 Each

Option 3 (CLIN 0004)

Additional inductively coupled plasma (ICP) tube - 1 Each